THEORY OF OPERATION

Circuit Composition And Operation Theory

The basic explanation for the circuit composition

2 FR540 consists mainly of the two board controlling the RF circuit parts and the digital circuit parts.

Receiver

FR540 receive parts are composed in the double conversion system, which has the 1st IF Frequency of 10.7MHz and the 2nd IF frequency of 450KHz, with the frontend circuit which has an excellent band characteristic and skite characteristic, the 1 pole MCF used in the 1st IF, and the 4 pole ceramic filter in the 2nd IF, the reception interrupting factors such as the image and the sensitivity repression are reduced for the more stable reception.

RF Frontend

The signal received by the antenna will be transmitted to the frontend through the antenna switching circuit consisted of C66, D11, L17, C109 and C22. The frontend consists of the RF amplifier transistor Q3 and input/output band pass filter (C115, L23, L21, L22). Band pass filter has the bandwidth of approximately 10MHz, primarily diminishes the other signal rather than the 1st IF image and other signal within the reception band and amplifies only the necessary signal within the RF.

1st Mixer

The receiver signal which has been amplified in the RF frontend is provided to the base of the 1st mixer Q4. The 1st L/O signal provided from the VCO circuit (Q9) is supplied to the emitter of Q4 and converted to the 1st IF 10.7MHz.

1st IF Filter and 1st IF Amplifier

The signal converted by Q4 to 10.7MHz, the 1st frequency, changes its impedance through L2 and then is infused to the fundamental MCF which has the center frequency of 10.7MHz and the band width of +/-12.5KHz.
Here, the signal reduces the image and other unwanted signal for the 2nd IF, and changes its impedance again through the L19 and C113. Then the signal is infused to the Q2, the 1st IF amplifier. The signal infused to the Q2 is amplified approximately by 20dB in order to acquire the required reception sensitivity, and infused to the IC1 which function as he 2nd mixer, the 2nd IF amplifier, and the FM detector.

2nd Mixer, 2nd IF, FM Detector(IC1)

The receiver IF signal of 10.7MHz, which has been infused to IC1 is mixed with the 2nd L/O signal of 10.250MHz, and converted to 450KHz, the 2nd IF frequency. The receiver signal converted to the 2nd IF frequency passed through the CF3, the ceramic filter of 455KHz again. After the limiting inside the IC1 and the FM demodulating by the quarter detector inside the IC1, the signal offers the output through the 9th pin of the IC1.
The 2nd L/O signal of 10.250MHz which infused to detect the noises from the received signal

demodulate in the 9th pin of the IC1. For this purpose, the noise filter is using the OP. Amplifier inside the IC1.

De-Emphasis

The audio signal which has been FM demodulate in he IC11 supplies to R124, C136, C137, R125 which function as the De-emphasis.

Audio Power Amplifier (IC6)

The received audio signal which has been adjusted to RV101, 102, 103 is supplied to the IC6 and amplified approximately by 20dB. Then, it turns up the speaker with the maximum output of 0.5Watts.
The 2th pin of the IC6 is the VDD.

Transmitter

The transmission part of the FR540 is designed to amplify the RF signal oscillated and modulated by the synthesizer to approximated below 500mW(ERP) by the power transistor of Q5, 6, 13, 14.

Pre-emphasis (IC5)

The voice signal input from the microphone is pre-emphasized at the IC5. The signal which comes out of the IC5 is limited to a certain amplitude for the voice signal not to exceed the allowable band width assigned for transmission.

TX Power(Q5,6,13,14)

The transmitted signal amplified to 0.5Watts here passes the TX LPF of the 2nd characteristic of the L4 and the L3, and RX / TX switching takes place by the D12.

Frequency Synthesizer

Voltage Control Oscillator(VCO)

The VCO of oscillates 462,5625MHz under the transmission condition and 473.2625MHz under the reception condition. The VCO consists of the colpit oscillator of the Q9, and contains the oscillator frequency of approximately 10.250MHz during the transmission / reception conversion. That is since the VCO should oscillate relatively low frequency during reception compared to transmission. Therefore as a result, the C25 is added in parallel to the resonance circuit of the VCO to oscillate a low frequency. During transmission, a relatively high frequency should be oscillated compared to transmission.
The VCO is controlled by the IC3 PLL IC in order to oscillate the accurate frequency. The output frequency of the VCO is supplied to the IC3 PLL IC immediately. At the IC3, 10.250MHz by the X2 is compared to the output frequency of the VCO. The VCO is controlled through the loop filter consisted of he R4, R38 and the C74 in order to oscillate the stable frequency wanted for the radio.
The VCO controlled voltage which has passed the loop filter supplies to the D6 variator diode, and he VCO and oscillate the PLL programmed frequency by the capacity variation in the D22. In addition, the L8 on the VCO circuit functions as frequency for the VCO to be properly controlled by the IC3 PLL IC.

RX/TX Buffer Amplifier (Q7, Q8)

The RF signal oscillated at the VCO is provided to the Q7 power driver amplifier through the Q8 during the transmission.

PLL Frequency Synthesizer (IC3)

The PLL synthesizer of the signal loop PLL circuit with the reference of 12.5KHz.
The IC3 PLL IC includes all the functions such as the reference oscillator, the driver, the phase detector, the lock detector, and the programmable divider.
At the reference oscillator, the 10,250MHz is connected to the pin 2 of the IC3 to oscillate the frequency of 10.250MHz.
The phase detector sends out the output power to the loop filter through 10th pin of the IC3.
If the oscillation frequency of the VCO is low compared to the referenced frequency, the phase detector sends out he output power in positive pulse. If the oscillation frequency of the VCO is high, phase detector sends out the output power in negative pulse. Therefore, the VCO can maintain the frequency set.

The programmable divider maintains the desired frequency with the control from the CPU. The dividing ratio, "N" to oscillate the desired frequency is as below:

N = VCO oscillation frequency / reference frequency

If the desired frequency is 462.5625MHz

N = 462.5625MHz / 0.00625MHz = 37005

CPU and Memory

Most of the control functions are controlled by the IC4 CPU.

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